

CLAIMS

1. A phase locked loop circuit, for providing an oscillating output signal at an output frequency, comprising:
 - a reference counter;
 - a loop counter;
 - a phase detector having a first input coupled to the reference counter and a second input coupled to the loop counter;
 - a voltage controlled oscillator having an input coupled to the output of the phase detector and an output for providing the oscillating output signal;
 - a feedback loop coupling the output of the voltage controlled oscillator to the input of the loop counter; and
 - delay circuitry, including a feedback loop, arranged to introduce a discrete delay into the output of the loop counter and/or the reference counter.
2. A phase locked loop circuit as claimed in claim 1, wherein the delay circuit temporarily introduces an off-set into the loop counter and/or the reference counter.
3. A phase locked loop circuit as claimed in claim 1 or 2, wherein the delay circuit comprises a variable delay component for introducing a continuously variable delay into the output of the loop counter and/or the reference counter.
4. A phase locked loop circuit as claimed in claims 3, wherein the delay circuitry comprises a detector for detecting when the variable delay component exceeds a threshold and control means for introducing a discrete delay in response to said detection.
5. A phase locked loop circuit as claimed in claim 3 or 4, wherein the delay circuit is arranged to compensate a variation in the discrete delay with a variation in the variable delay.
6. A phase locked loop circuit as claimed in claim 3, 4 or 5, wherein the delay circuitry is arranged such that a maximum variable delay is substantially equal to a minimum discrete delay.

7. A phase locked loop circuit as claimed in any one of claims 3 to 6, wherein the delay circuitry comprises a feedback loop which provides an input to the variable delay component that is dependent upon both the voltage at the input to the voltage controlled oscillator and the discrete delay introduced into the loop counter and/or the reference counter.
8. A phase locked loop circuit as claimed in claim 7, wherein the delay circuit temporarily introduces an off-set into the loop counter and/or the reference counter and comprises: a summation means for summing the introduced offsets; a digital to analogue conversion means for converting the total introduced offset into an analogue signal representing the total introduced discrete delay; and subtraction means for subtracting the analogue signal from a signal representative of the voltage at the input of the voltage controlled oscillator to produce the input to the variable delay component.
9. A phase locked loop circuit as claimed in any preceding claim, further comprising a shunt capacitor connected between a node between the phase detector and the voltage controlled oscillator and ground.
10. A phase locked loop circuit as claimed in any preceding claim, wherein the phase detector output is coupled to the input of the voltage controlled oscillator via an intervening loop filter consisting of a capacitor.
11. A frequency synthesiser comprising a phase locked loop circuit as claimed in any preceding claim.
12. A method of changing the frequency of an oscillating output signal comprising the steps of:
adapting the reference counter and/or the loop counter of a phase locked loop; and
introducing a discrete delay into the output of the loop counter and/or the reference counter.
13. A method as claimed in claim 12 further comprising the step of introducing a continuously variable delay into the output of the loop counter and/or the reference counter.

14. A method as claimed in claim 13, wherein a temporary variation of the discrete delay results in a corresponding permanent variation in the variable delay.

15. A frequency synthesiser, for providing an oscillating output signal at an output frequency, comprising:

frequency compensation means arranged to maintain the output frequency; and feedback means arranged to vary discretely the phase of an input signal provided to the compensation means.

16. A frequency synthesiser as claimed in claim 15, wherein the feedback means is additionally arranged to vary continuously the phase delay of the input signal.

17. A frequency synthesiser as claimed in claim 15, wherein the compensation means comprises: an input for receiving a first input signal; comparison means for comparing the first input signal and a second input signal; control means for controlling the output frequency in dependence upon the comparison; and a negative feedback loop for providing the second input signal.

18. A frequency synthesiser as claimed in claim 17, wherein the comparison means is a phase detector.

19. A frequency synthesiser as claimed in claim 17 or 18, wherein the control means comprises a capacitor, a voltage controlled oscillator having its input connected to the capacitor and means for sourcing and sinking current to said capacitor and thereby control the output of said voltage controlled oscillator and the output frequency.

20. A frequency synthesiser as claimed in any one of claims 17, 18 or 19, wherein the negative feedback loop comprises programmable means for adjusting the second input signal.

21. A frequency synthesiser as claimed in claim 20, wherein the programmable means is a counter.

22. A frequency synthesiser as claimed in any one of claims 17 to 21, wherein the feedback means is additionally arranged to continuously vary the phase delay of the first

input signal.

23. A frequency synthesiser as claimed in any one of claims 17 to 21, wherein the feedback means is additionally arranged to continuously vary the phase delay of the second input signal.

24. A frequency synthesiser as claimed in claim 22 or 23, wherein the feedback means comprises a negative feedback loop.

25. A phase locked loop circuit, for providing an oscillating output signal at an output frequency, comprising:

a loop counter;

a phase detector having a first input coupled to the reference counter and a second input coupled to the loop counter;

a voltage controlled oscillator having an input coupled to the output of the phase detector and an output for providing the oscillating output signal;

a feedback loop coupling the output of the voltage controlled oscillator to the input of the loop counter; and

delay circuitry, including a feedback loop, arranged to introduce a discrete delay into the output of the loop counter.

26. A method of changing the frequency of an oscillating output signal comprising the steps of:

adapting a loop counter of a phase locked loop; and

using a feedback loop to introduce a discrete delay into the output of the loop counter.

27. A frequency synthesiser, for providing an oscillating output signal at an output frequency, comprising:

frequency compensation means comprising: an input for receiving a first input signal; comparison means for comparing the first input signal and a second input signal; control means for controlling the output frequency in dependence upon the comparison; and a negative feedback loop for providing the second input signal; and feedback means arranged to vary discretely the phase of the first input signal and to vary continuously the phase of the first input signal.

28. A frequency synthesiser as claimed in claim 27, wherein the comparison means is a phase detector.

29. A frequency synthesiser as claimed in claim 27 or 28, wherein the control means comprises a capacitor, a voltage controlled oscillator having its input connected to the capacitor and means for sourcing and sinking current to said capacitor and thereby control the output of said voltage controlled oscillator and the output frequency.

30. A frequency synthesiser as claimed in any one of claims 27, 28 or 29, wherein the negative feedback loop comprises programmable means for adjusting the second input signal.

31. A frequency synthesiser as claimed in claim 30, wherein the programmable means is a counter.

32. A frequency synthesiser, for providing an oscillating output signal at an output frequency, comprising:

frequency compensation means comprising: an input for receiving a first input signal; comparison means for comparing the first input signal and a second input signal; control means for controlling the output frequency in dependence upon the comparison; and a negative feedback loop for providing the second input signal; and feedback means arranged to vary discretely the phase of the second input signal and to vary continuously the phase delay of the second input signal.

33. A frequency synthesiser as claimed in claim 32, wherein the comparison means is a phase detector.

34. A frequency synthesiser as claimed in claim 32 or 33, wherein the control means comprises a capacitor, a voltage controlled oscillator having its input connected to the capacitor and means for sourcing and sinking current to said capacitor and thereby control the output of said voltage controlled oscillator and the output frequency.

35. A frequency synthesiser as claimed in any one of claims 32, 33 or 34, wherein the negative feedback loop comprises programmable means for adjusting the second input

signal.

36. A frequency synthesiser as claimed in claim 35, wherein the programmable means is a counter.

37. A phase locked loop substantially as hereinbefore described with reference to and/or as shown in the accompanying Figs. 2, 3, 4 and 5.

38. Any novel subject matter or combination including novel subject matter disclosed, whether or not within the scope of or relating to the same invention as the preceding claims.